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Quantifying Sand and Gravel consumption in the development of East Dhaka, Bangladesh

INTRODUCTION TO SAND AND GRAVEL MINING:

Bangladesh is a country located in South Asia (Figure 1), with a sizable portion of its landmass at or below sea level. As a result, it is highly vulnerable to the impacts of climate change (Figure 2), including rising sea levels, increased frequency and intensity of floods, and more severe storms. In 2017 a major flood inundated 30% of the country's land area affecting more than 5.7 million people [1]. Bangladesh Centre for Advanced Studies (BCAS) reported that a one-meter rise in sea level would affect approximately 17% of Bangladesh's land area affecting around 20 million people (about the population of New York state) [2].

Figure 1: A labelled red arrow points towards the light green highlighted silhouette of Bangladesh within the global context [3].

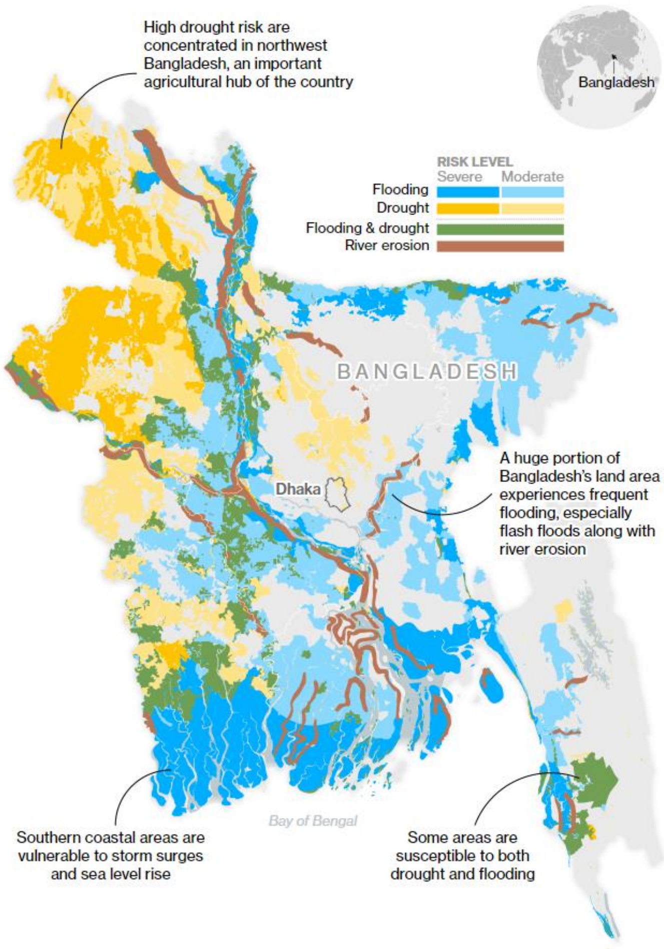
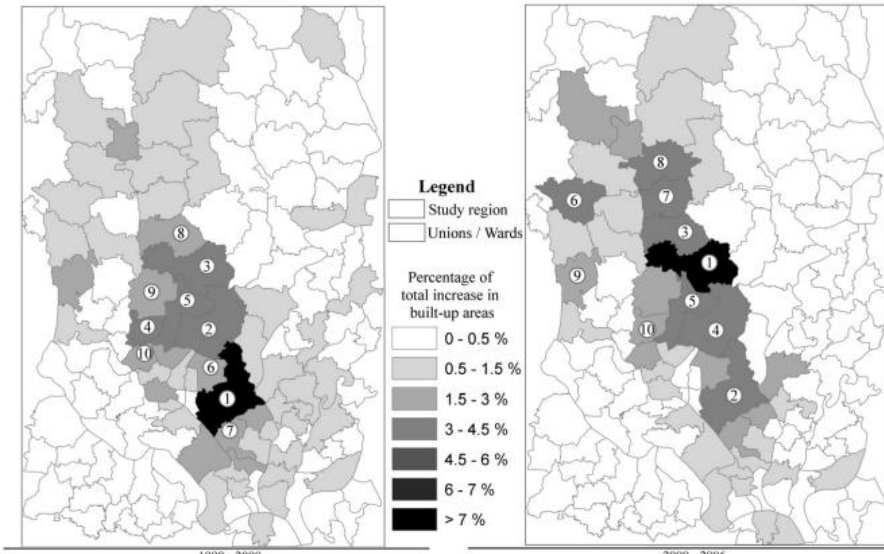


Figure 2: Areas of Bangladesh that are at environmental risk are highlighted in different colors. The different shades of blue indicate severity of floods. Yellow indicates drought, green indicates flooding and drought overlap, and brown indicates river erosion [4].

Dhaka, the capital city of Bangladesh (Figure 3) and is one of the fastest-growing cities in the world (around 2,000 people every day relocate to the megacity) [5]. A booming garments industry and a steady flow of remittances have kept migration and investment into the city strong. This rapid growth has led to an increased demand for construction from its burgeoning population. In 2008, population densities ranged from approximately 30,000 inhabitants/km^2 for the city area to over 220,000 inhabitants/km^2 in informal settlement areas [6]. By 2011 the City of Dhaka passed *The Local Govt. (City Corporation) Amendment Act (2011)* which split the city into two separate city corporations to manage development (Dhaka North City Corporation and Dhaka South City Corporation) [7].

These pressures have spurred the widespread practice of landfilling to create new land for development. The landfilling process is when sand that was mined (either from riverbed dredging or floodplain excavation), is pumped into wetlands to produce a suitable foundation for construction. From 1990 to 2006 urban land use increased by 270% at the expense of agriculture and wetland areas [8]. From 1990-2000 landfilling efforts began in the southern wards (smallest administrative divisions of Dhaka city) and pushed northwards from 2000 – 2006 (Figure 4). However, by 2006, urban growth had begun to shift eastwards (Figure 5).

Figure 3: A map of Bangladesh. The capital of Dhaka is marked with a bright red square. Administrative divisions are marked in different colors and are labeled. (Rangpur in dark green, Rajshahi in yellow, Dhaka in purple, Khulna in baige, Barishal in orange, Chittagong in light green, and Sylhet in peach [9].



1990 - 2000

Rank	Union name	Percent of total increase in built-up areas	Absolute increase in built-up areas (ha)
1	DEMRA	7,71	650,12
2	GULSHAN	3,97	334,24
3	UTTARA	3,86	325,47
4	MIRPUR	3,77	317,43
5	CANTONMENT	3,43	289,16
6	SABUJBAGH	2,66	224,18
7	KUTUBPUR	2,63	221,91
8	PAURASHAVA (GAZIPUR)	2,45	206,88
9	PALLABI	2,26	190,47
10	MOHAMMADPUR	2,25	189,50

2000 - 2006

Rank	Union name	Percent of total increase in built-up areas	Absolute increase in built-up areas (ha)
1	UTTARA	8,43	809,57
2	DEMRA	5,68	545,26
3	PAURASHAVA (GAZIPUR)	4,96	476,06
4	GULSHAN	4,29	411,65
5	CANTONMENT	3,82	367,14
6	DHAMSANA	3,79	363,40
7	GACHHA	3,55	341,06
8	BASAN	3,43	329,37
9	PAURASHAVA (SAVAR)	2,88	276,25
10	MIRPUR	2,81	270,24

Figure 4: Hotspot analysis of the increase in built-up areas based on administrative units (wards). Each ward is numbered in order by absolute increase in built up areas. The table below each image provides the ward name, percent of total increase in built-up areas, and absolute increase in built-up areas associated with each number. The image and table on the left show the trends from 1990 – 2000, while the ones on the right show the trends from 2000-2006 [10].

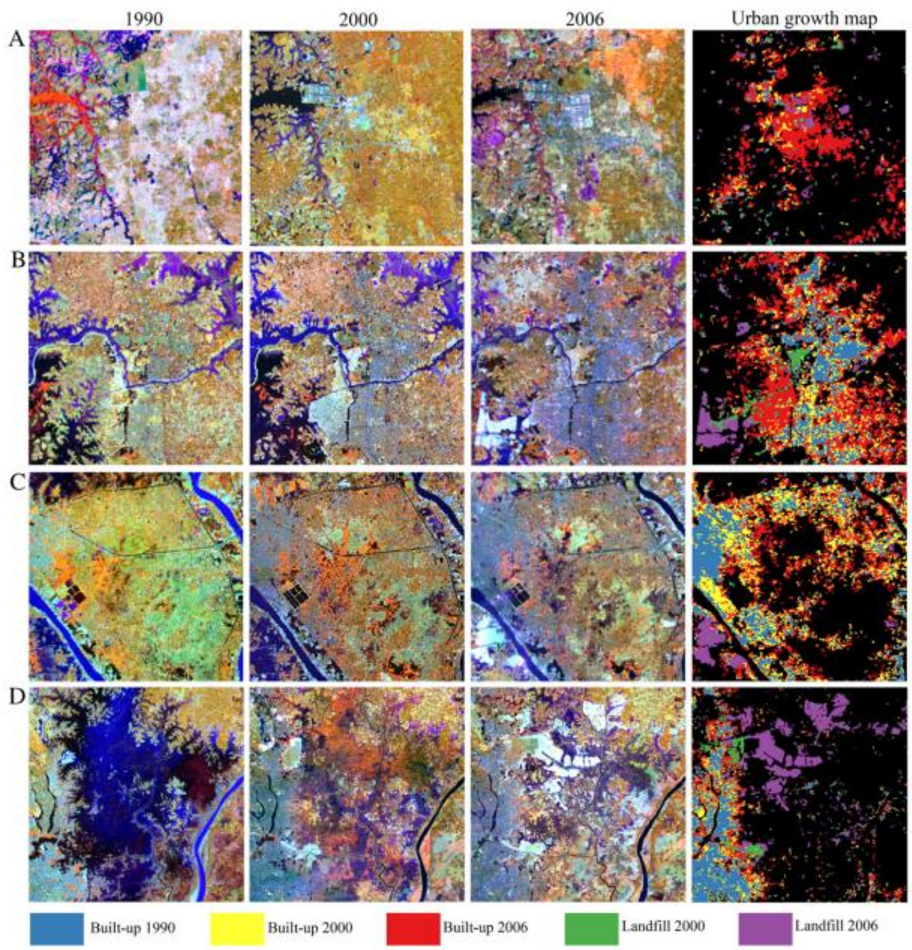


Figure 5: Details from Landsat imagery (R= b4; B= b5; G= b3) for 1990, 2000 and 2006 as well as the corresponding areas from the urban growth map. (A) Example of industrial sprawl revealed by the analysis: development of the Export Processing Zone, a large cluster of the national garment industry. (B) Model Town development in Uttara: this Model Town was partly constructed on land in-fillings and the 2006 imagery shows more recent in-fillings. It exemplifies the regional practice of urban development in the absence of buildable land. (C) Agricultural land loss due to urban expansion: urbanization within the city union of Demra. (D) Extensive land in-fillings: Development of the Bashundara Residential Area on the eastern fringe of Dhaka City bordering into the adjacent wetlands. Varying scales from 1:35,000 (A) to 1:65,000 (D) [11].

The western portion of the city has been almost entirely converted into Builtup land which has been heavily urbanized (Figure 6). The growth has now shifted towards the eastern portion of the city which is mainly rural and has a vast amount of wetlands to be reclaimed [12]. Automated dredgers and pumping activates (Figure 7) can be viewed all along the Balu River in East Dhaka. East Dhaka is a congregation of wards east of the developed western portions (Figure 8). The bound of East Dhaka ends with the Balu River, however, land filling activities extend beyond this border (Figure 9) so for the purpose of this research, dumping activities beyond the Balu river will be considered as part of East Dhaka as well. The intense demand for more housing and the scarcity of land has caused the price per square meter of land in

Bashundhara Residential Area (a large housing development in east Dhaka) to surge from $24-$83 USD in 2000 to $94-$120 by 2016 [13].

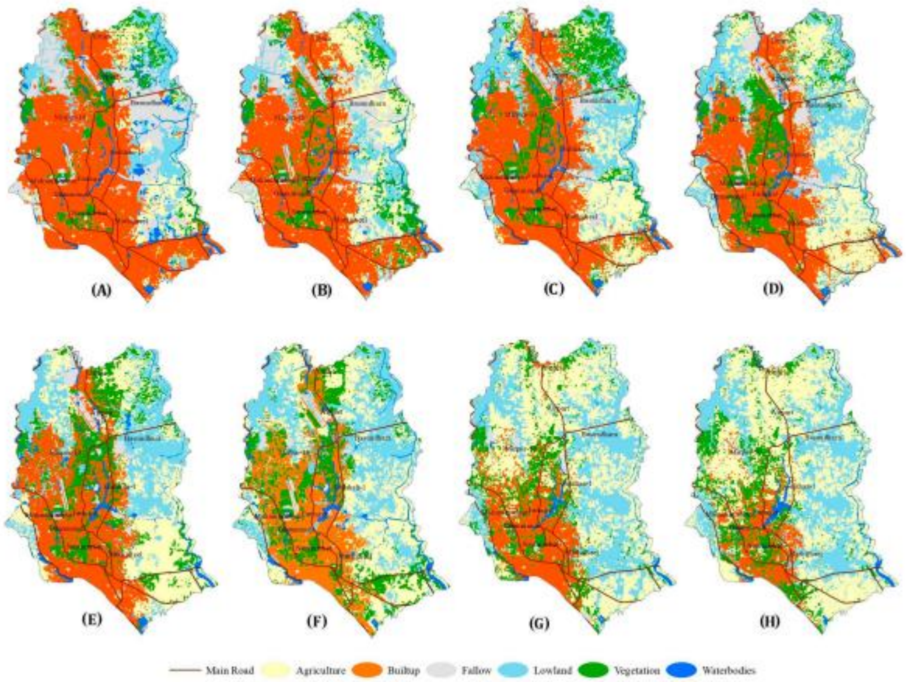


Figure 6: Land cover map of the Core city/Dhaka City Corporation area (DCC) between 1972 and 2015. (A) 2015; (B) 2010; (C) 2005; (D) 2000; (E) 1995; (F) 1990; (G) 1980; (H) 1972 [14].

Figure 7: A dredging boat pumping sand into a landfill site [15].

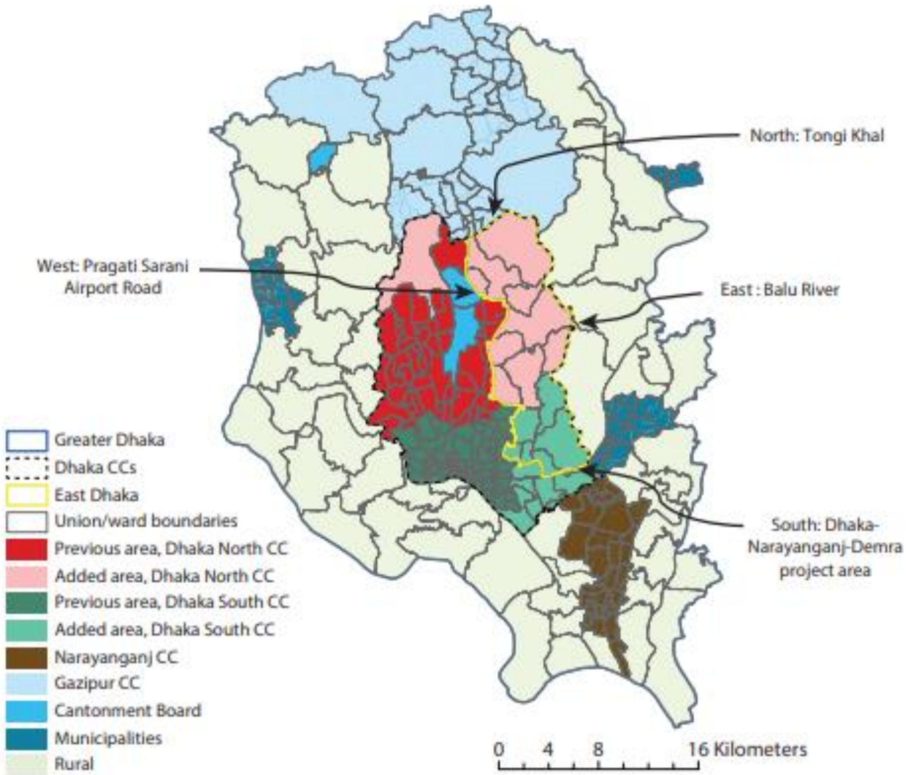


Figure 8: An map of Dhaka city and great Dhaka split into administrative wards. The colors indicate CCs (City corporations) and other administrative qualities. The yellow line portrays the borders of East Dhaka [16].

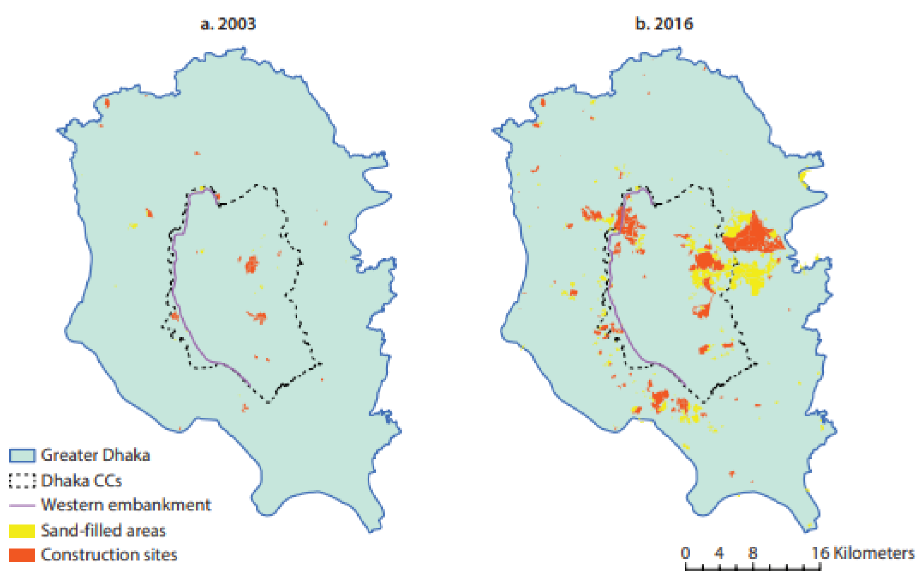


Figure 9: Areas of Construction and Sand Fill intensity from 2003 and 2016. The yellow represents sand-filled areas, and the orange represents construction sites [17].

Once the landfilling has produced a suitable foundation, construction with concrete may begin. While sand is an important ingredient in concrete, the introduction of sandy gravel into concrete greatly increases its compressive strength which has led to the formation of a crushed stones mining industry adjacent to sand mining (Figure 10). Gravel is also a key component in infrastructure production and maintenance, mainly roads. Due to the high presence of moisture in Bangladeshi roads (Figure 11), water damage is extremely common, affecting roads in as little as two years after construction (Figure 12).

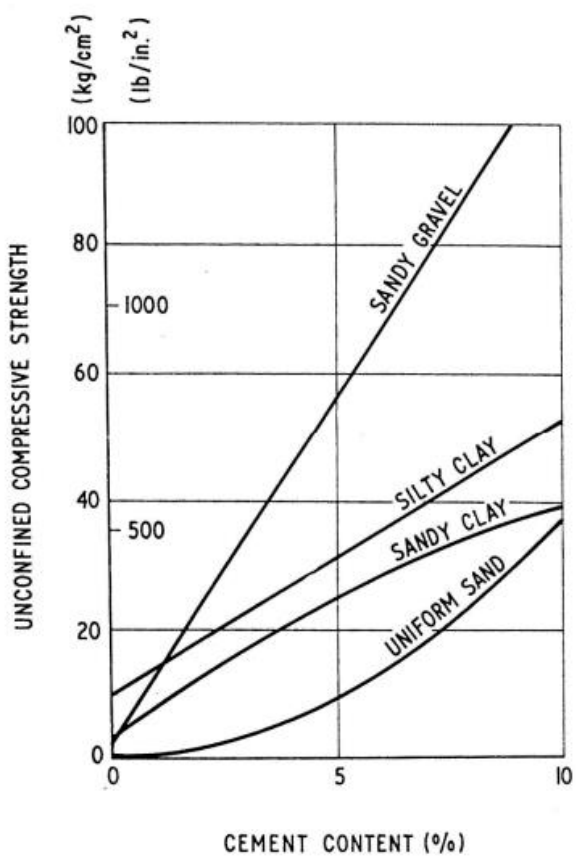


Figure 10: Effect of cement content on strength of various soils cured for seven days [18].

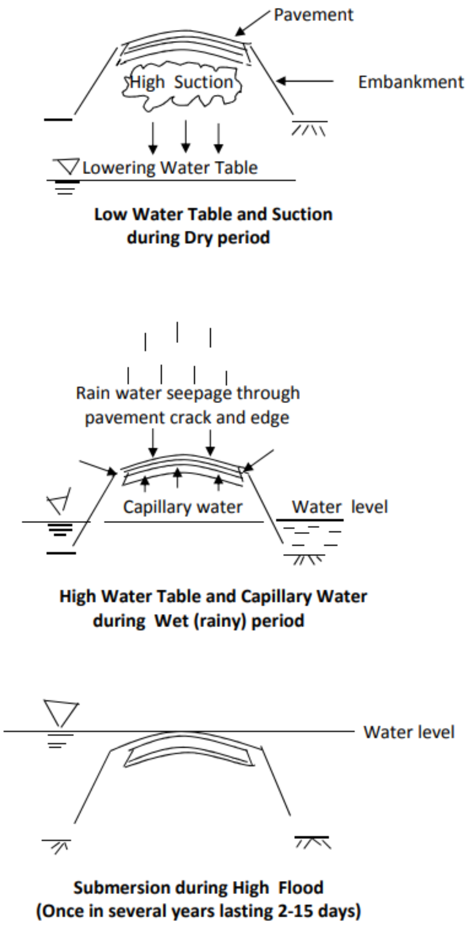


Figure 11: Pavement moisture condition in different periods in Bangladesh [19].

Figure 12: Road damaged by recent flooding [20].

Landfilling and construction keep sand and gravel in high demand, producing lucrative mining industries. This paper aims to indicate if East Dhaka's development is the main driving force behind the sharp increase in sand and gravel consumption.

METHODOLOGY:

Despite recent measures, such as the Quarry and Soil Management Act of 2011, both the gravel and sand mining industry in Bangladesh remain largely unregulated. Of approximately 1000 trucks that transport these goods, only 200 will ever be taxed [21]. In addition to the lack of official monitoring, extraction varies greatly across the countries 700 rivers, ranging from small scale hand dredging to large scale automated suction dredges. These challenges make it difficult to quantify the amount of sand and gravel being extracted each year. However, a series of factors can be used as proxies to make reasonable inferences. The flowcharts below depict how we can use these different factors to derive estimates of the weight of sand and gravel.

First the weight of sand flowing through a single sand market in Dhaka (Goptali sand market) will be compared to the total weight of sand in the domestic construction industry of 1990. This will give a scale of the explosive growth in sand demand.

Then the weight of sand of gravel imported in 2020 will be estimated using OEC data. This will be compared to the aggregated value of the weight of sand from land filling activity from 2020 in East Dhaka and the domestic construction industry of 2020.

Finally, a comprehensive analysis of land filling activities from 2001 – 2020 in 2-year intervals will be calculated using remote sensing data with a breakdown of area coverage per upazila. This will be compared to trends noticed in the literature tracking built-up areas of Dhaka.

FINDING THE WEIGHT OF SAND IN GOBTALI MARKET, DHAKA IN 2022:

The number of trucks spotted daily multiplied by their weight capacity will give the daily weight of sand (Figure 13).

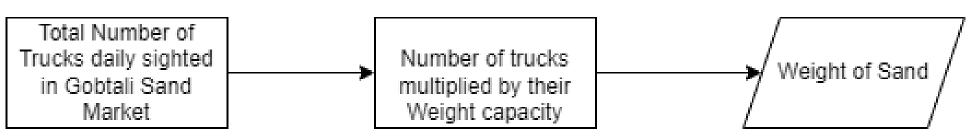


Figure 13: An estimation of trucks from a merchant in Gobtali market is obtained. This is multiplied by the weight capacity of each truck yielding the total daily weight of sand flowing through the market in 2022.

FINDING THE WEIGHT OF DOMESTIC SAND EXTRACTION IN 1990:

Knowing the percent of concrete that was imported allows us to infer that the remaining percent was domestic production. This value is converted to Taka with the appropriate exchange rate, and then changed manipulated to achieve the number of bags. This number is multiplied by weight of the bags to find the weight of concrete. The sand component is then isolated yielding the weight of sand (Figure 14).

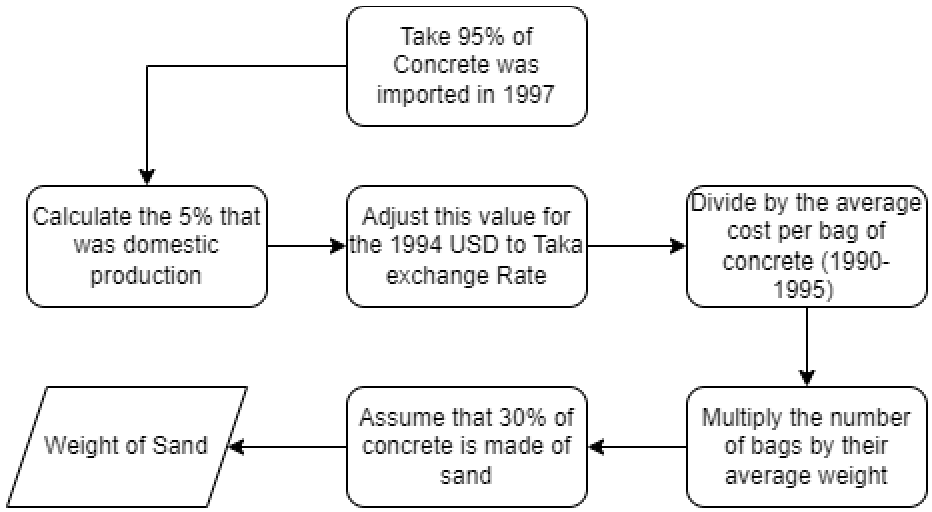


Figure 14: Using the information that 95% of concrete was imported in 1995, the remaining 5% will represent the domestic production of concrete. Once this is attained in USD this will be converted to Taka and divided by the average cost of a bag of concrete to yield the number of bags. This value is multiplied by their weight to yield the weight of concrete. Knowing that 30% of concrete is sand will yield the weight of sand.

FINDING THE WEIGHT OF IMPORTED GRAVEL CONSUMPTION IN 2020:

One way to estimate the imported gravel consumption in Bangladesh in 2020 is by using the USD value of gravel imports for the year and dividing it by the known price per metric ton of gravel. By doing this, one can determine the approximate metric tons of gravel that were imported into the country during that year (Figure 15).

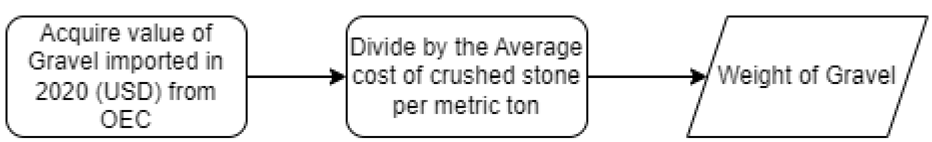


Figure 15: The imported value in USD is divided by the acreage cost per ton to yield the weight of gravel.

FINDING THE WEIGHT OF IMPORTED SAND EXTRACTION IN 2020:

First the import value of sand in USD is attained. Sand pricing varies wildly depending on quality. High quality silica sand costs far more than natural sand. Two estimates of sand weight will be made, a lower estimate and a higher estimate. When the higher cost sand is divided from the total import cost, it will produce a smaller value, or a lower estimate. The lower cost sand when divided by the total import cost, will result in a higher value, or higher estimate (Figure 1).

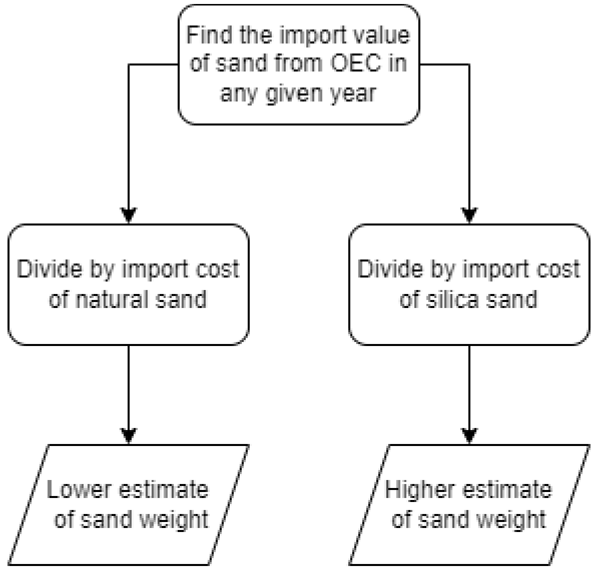


Figure 16: An import value in USD is divided by a high-cost estimate and a low-cost estimate to produce a lower and higher estimate of sand weight.

FINDING THE WEIGHT OF AGGREGATE WEIGHT OF SAND AND GRAVEL FROM THE CONSTRUCTION INDUSTRY IN 2020:

The per capita concrete consumption will be multiplied by the population of the country. This will yield the total weight of concrete. Based on the known composition of concrete it will then be split into its sand and gravel components (Figure 17).

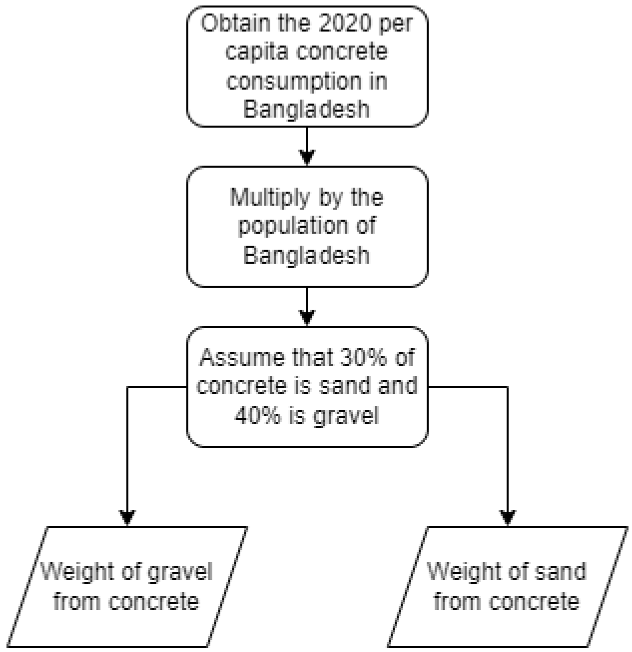


Figure 17: The per capita consumption value is multiplied by the population to attain a total weight of concrete. This weight is then divided into its sand and gravel components.

CALCULATING THE AREAS OF LANDFILLING:

Remote sensing data will be used to identify areas of land reclamation in East Dhaka in 2 year increments from 2001 to 2020. Each upazila will be examined and the areas that exhibit land reclamation will be marked by shapefiles and aggregated (Figure 18). The area of each upazila per year will be compiled and analyzed in the discussion section. These areas can be multiplied by a known height to attain the volume of sand. An approximate density of sand will then be used to convert the volume into a weight (Figure 19).

Figure 18: An example of shapefiles traced onto instances of land reclamation in the wetlands of East Dhaka. The black lines shows a border between two upazilas. The landmasses north of the line will be recorded under the Kilkhet upazila and the landmasses south of the line will be recorded in the Badda upazila.

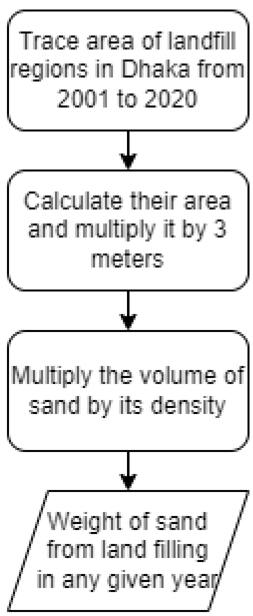


Figure 19: Areas are attained by tracing land fill regions and multiplied by a height to attain volume. This is then multiplied by a density to attain weight.

RESULTS:

Total sand consumed in Gobtali Market, Dhaka in 2022:

A merchant from the Gobtali sand market claimed that 800-1000 trucks a day come through the market [22]. The figure of 1000 was used to produce an upper estimate. Based off visual observations made in the field the correct truck was obtained from Auto Bangla website where its weight capacity was determined to be 3,800 kg [23].

3,800kg/truck * 1000 trucks = 3,800,000 kg or 3,800 metric tons

Reports indicate that 1000 trucks carrying 3,800 kg each will yield a daily flow of 3,800 metric tons of sand in Goptali market.

Total through sand imports in 1990:

In 1995, 95% of all concrete was imported from abroad. The remaining 5% must be domestic production [24]. The imported value in 1997 was $130 million USD [25]. Isolating the 5% of concrete production that was met domestically (130/.95)-130) gives 6.84 million USD. Using the 1994 exchange rate, 18 Taka/dollar, this till be converted to Taka [26]. The average cost of a bag of concrete from 1990 to 1995 was 200 taka/bag and their average weight was 50kg [27]. The weight will be divided from the Taka amount, granting the number of bags. This number will be multiplied by the average weight to give the weight of concrete. Knowing the composition of the concrete will then yield the final weight of sand.

6.84 * 18 = 123,120,000 taka

123,120,000 taka / 200 bag= 615,600 bags

615,600 bags * 50 kg per bag = 30,780,000 kg

30,780,000 kg * .3 = 831,060 kg

831,060 kg or 831 metric tons

Given the knowledge that from 1997 imports, it can be estimated that 831 metric tons of sand were imported in the year of 1990.

Imported gravel consumption in 2020:

One way to estimate the imported gravel consumption in Bangladesh in 2020 is by using the USD value of gravel imports for the year and dividing it by the known price per metric ton of gravel. By doing this, one can determine the approximate metric tons of gravel that were imported into the country during that year. Due to the enforcement of gravel mining bans it can be assumed that the vast majority of gravel used is sourced internationally. The import value of crushed stone stood at $200 million and Bangladesh exports of crushed stone were a mere $23.4 thousand, and including the fact that all the major quarries in Bangladesh had been closed, it is safe to assume that virtually all gravel in the country is sourced from aboard [28]. The index box report, *World - Gravel and Crushed Stone - Market Analysis, Forecast, Size, Trends and Insights* provides the price of $13.15 per metric ton [29]. Since a significant portion of the country's gravel needs are met through imports from countries such as India and the UAE, tracking gravel consumption can be relatively straightforward, as data on international trade flows and customs records are readily available. Since a significant portion of the country's gravel needs are met through imports from neighboring countries such as India and the UAE, tracking gravel consumption can be relatively straightforward, as data on international trade flows and customs records are readily available.

$$\$200 \text{ million} / \$13.15/\text{ton} = 15{,}209{,}125.48 \text{ tons}$$

Given an import value of $200 million, the country of Bangladesh imported 15,209,125.48 tons of crushed stone and gravel.

Imported sand consumption in 2020:

OEC combines both silica/quartz sand and natural sand data into a singular sand category [30]. However, the price of both sands differs immensely. Natural sand stood at $31 per ton in 2021 (a 34.2% decline against the previous year), while import costs of silica sand for Bangladesh stood at $535 per ton (an 18% increase against the previous year) [31, 32]. This is significantly higher than the average global import price of silica sand at $53 per ton in 2021 [33]. Due to this significant price disparity 2 figures will be calculated, one assuming the highest possible price, and one assuming the lowest possible price.

Higher estimate:

$$x - .342x = \$31/\text{ton}$$

$$.658x = \$31/\text{ton}$$

$$x = \$47.11/\text{ton} \text{ (import cost for natural sand per ton in 2020)}$$

$$\$3.31 \text{ million}(3{,}310{,}000) / \$47.11/\text{ton} = 66{,}440.25 \text{ metric tons}$$

Lower Estimate:

$$1.18x = \$535/\text{ton}$$

$$x = \$453.39/\text{ton} \text{ (import cost for silica sand per ton in 2020)}$$

$3.31 million(3,310,000) / $453.39/ton = 7,300.56 metric tons

Given an import value of $3.31 million in 2020, a higher estimate of 66,440.25 metric tons or a lower estimate of 7,300.56 metric tons were brought into country.

Sand and Gravel weight from 2020 construction industry:

The 2020 per capita concrete consumption of Bangladesh is 200 kg/person which will be multiplied by the population of the country (170 million) to attain the total concrete consumption for 2020 [34, 35]. Knowing that the makeup of concrete 30% is sand and 40% is gravel, the weight of concrete can be partitioned into its two components [36].

200kg per person * 170 million = 34.0 billion(34000000000)kg

34000000000 * .3 = 10,200,000,000

310,200,000,000 * .4 = 13,600,000,000

10,200,000,000 kg sand and 13,600,000,000 kg gravel

10,200,000 metric tons of sand and 13,600,000 metric tons of gravel

With a concrete consumption of 200kg per capita, 10,200,000 metric tons of sand and 13,600,000 metric tons of gravel were used in concrete production.

Landfilling results:

Figure 20 shows the upazilas of Dhaka and their names. 72.18 square kilometers of land have been reclaimed by sand land filling from 2001-2020 (Figure 21). 2.54 square kilomters of land were reclaimed in Sabjubagh, Demra, and Jatrbari (Figure 22). 30.05 square kilomteres were reclaimed in Badda and Khilket (Figure 23). 0.63 square kilometers were reclaimed in Rampura (Figure 24). 2.3 square kilometers were reclaimed in Khilgoan (Figure 25). 38.39 square kilometers were recalimed in Rupaganj and Kaliganj (Figure 26). Badda, Khilket, Rupganj, and Kaliganj saw the highest instances of landfilling activity (Figure 27). Figure 28 displays a visual spread of land filling activity from 2001-2020, showing a trend of increasing area moving eastward.

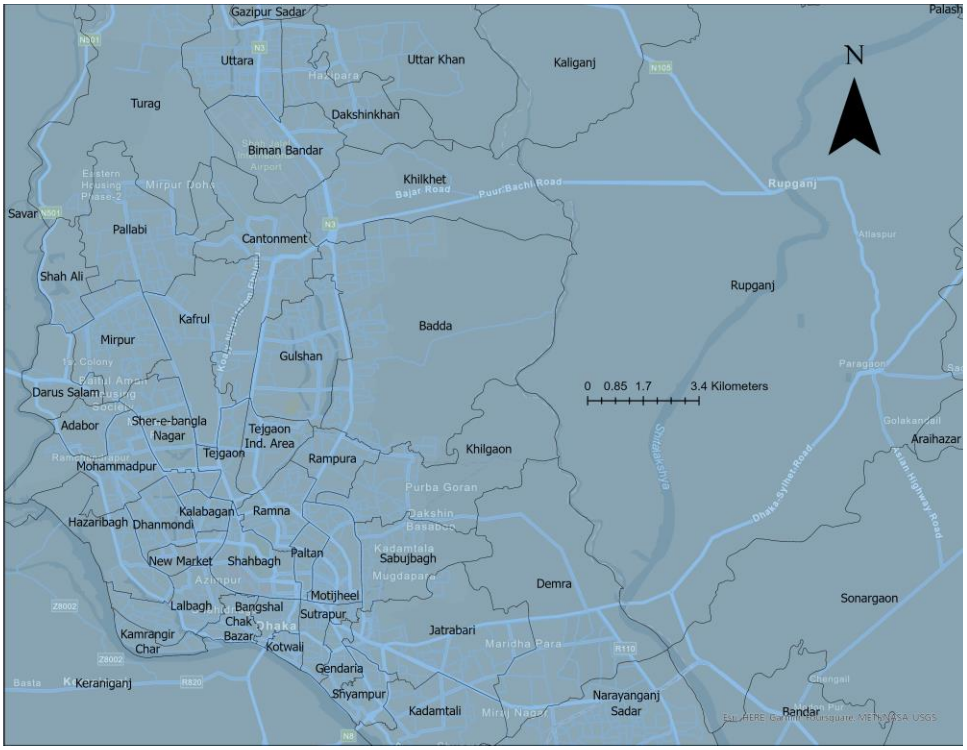


Figure 20: A map of Dhaka split into upazilas labelled with their names

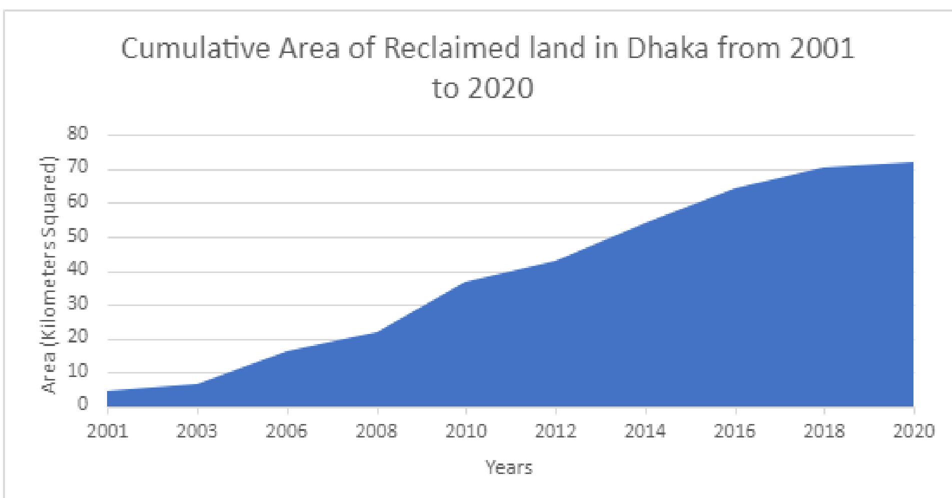


Figure 21: Cumulative square kilometersof land filled in the entirety of east Dhaka. The y axis is area in square kilometers and the x axis is years.

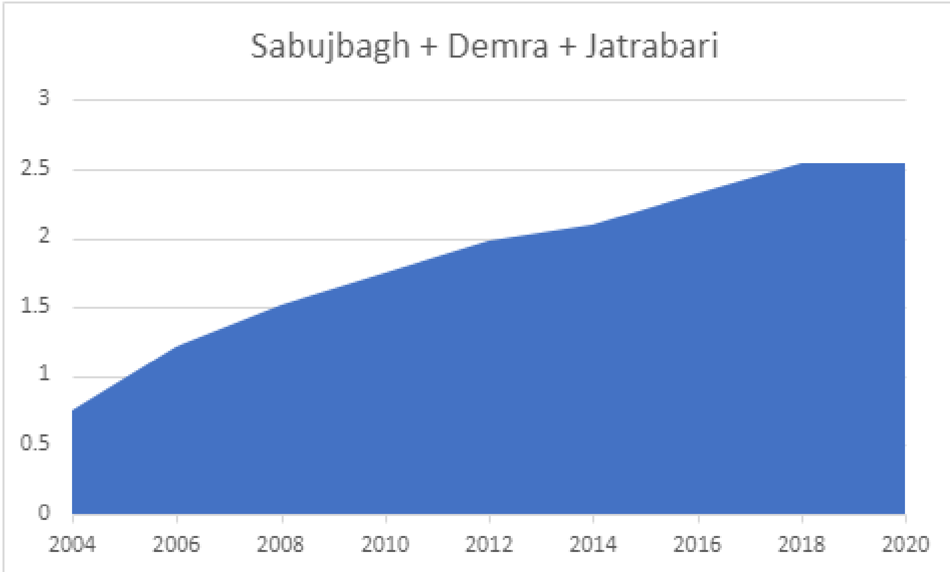


Figure 22: Cumulative square km of land filled in the upazilas of Sabjubagh, Demra, and Jatrbari. The y axis is area in square kilometers and the x axis is years.

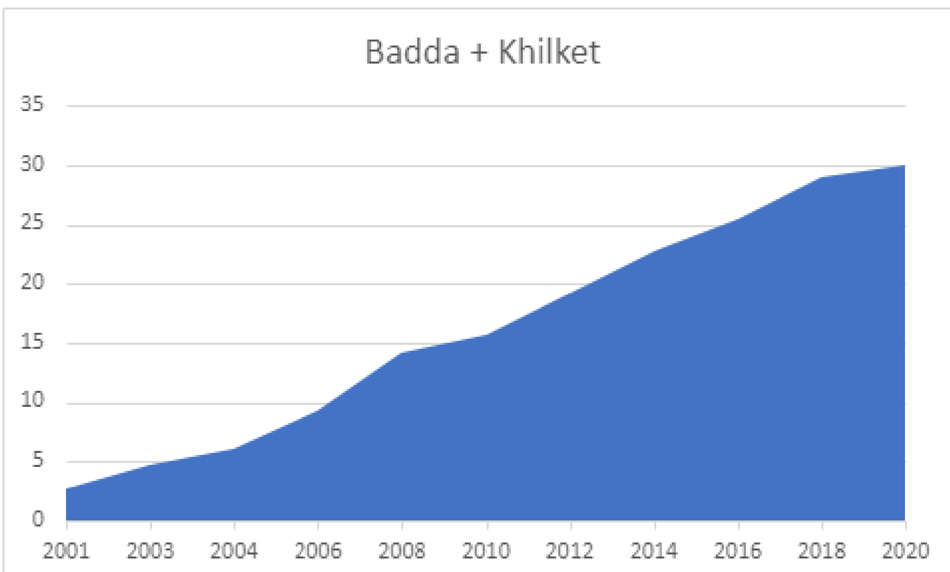


Figure 23: Cumulative square km of land filled in the upazilas of Badda and Khilket. The y axis is area in square kilometers and the x axis is years.

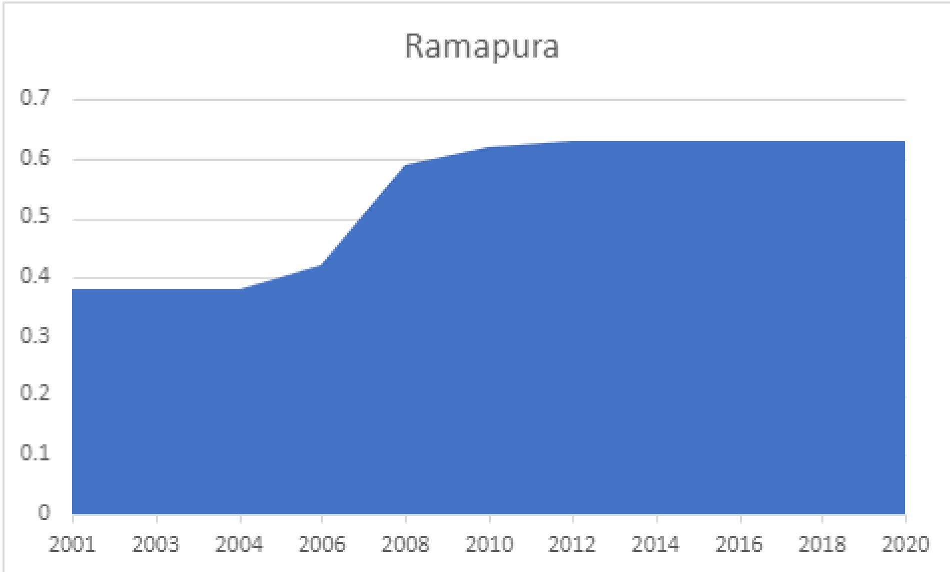


Figure 24: Cumulative square km of land filled in the upazila of Ramapura. The y axis is area in square kilometers and the x axis is years.

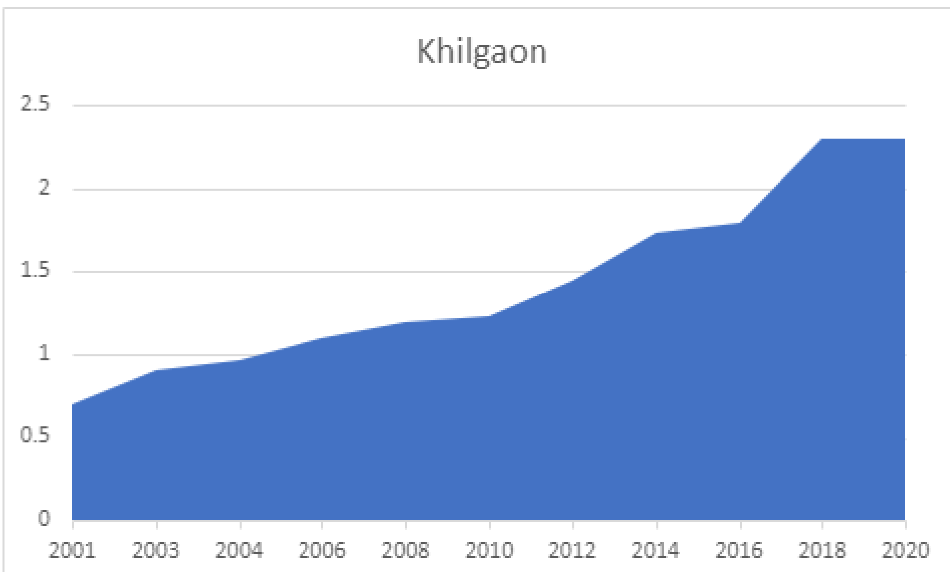


Figure 25: Cumulative square km of land filled in the upazila of Khilgaon. The y axis is area in square kilometers and the x axis is years.

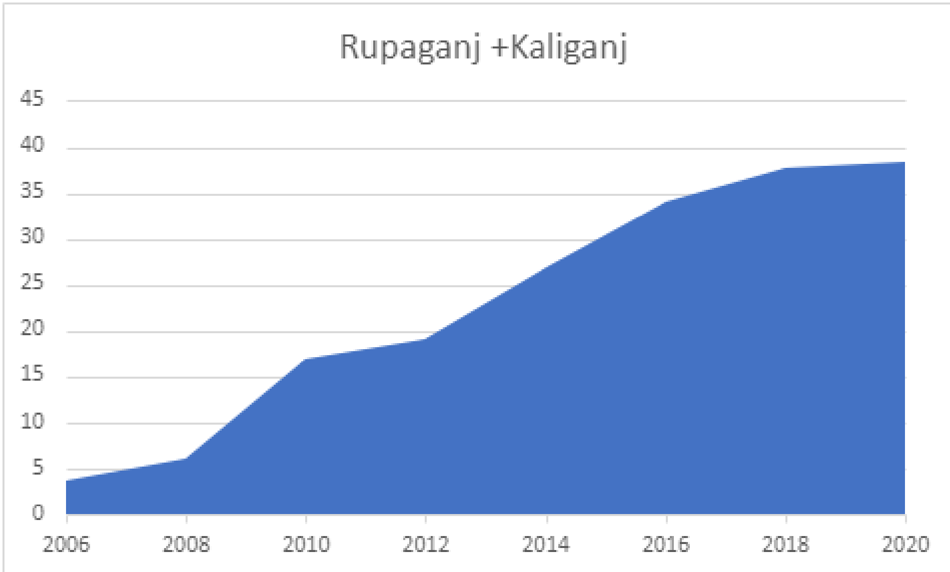


Figure 26: Cumulative square km of land filled in the upazilas of Rupaganj and Kaliganj. The y axis is area in square kilometers and the x axis is years.

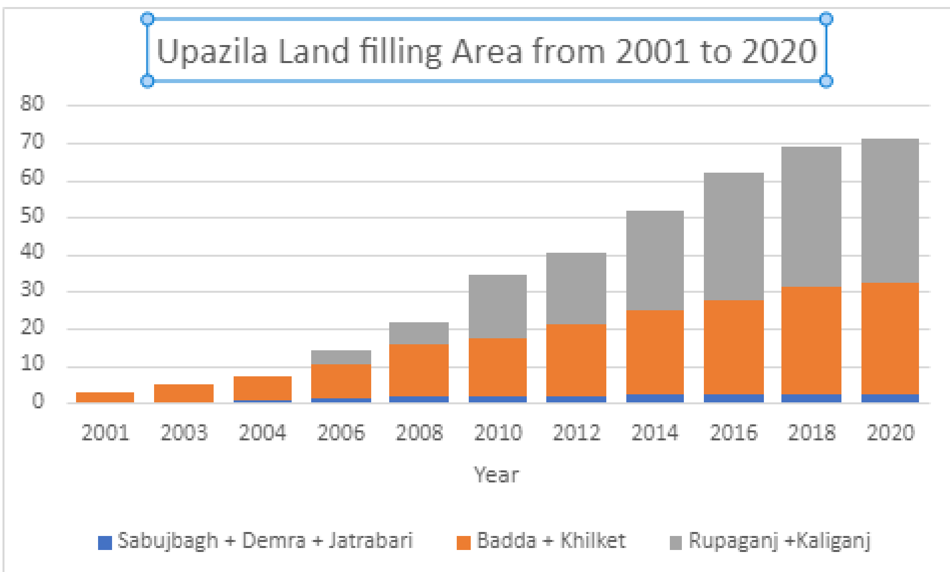


Figure 27: A cumulative bar chart of the 3 Upazilas that experienced the largest amount of sand dumping. The y axis is area in square kilometers and the x axis is years.

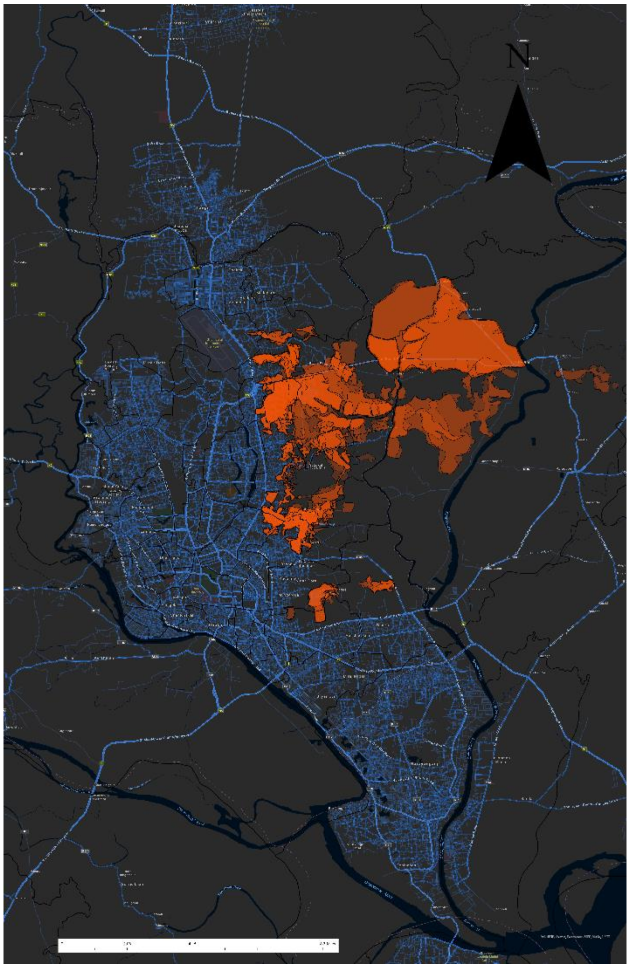


Figure 28: Areas affected by Sand Mining from 2001-2020 (Opaque areas indicate earlier dumping while translucent areas indicate more recent activity)

72.18 squared km* 3m = .21655 cubic km

1600 kg/cubic meter = 1.6 * 10^12 kg/cubic km

3.46 * 10^11 kg = 346,000,000 metric tons dumped from 2001 to 2020

Given the area of total landfilling activity (72.18 squared km) the total weight of sand dumped from 2001 to 2020 was 346,000,000 metric tons.

For 2018 - 2020:

Subtracting the total cumulative value of 2020 from the cumulative value of

(72.18 squared km-70.56 squared km) = 1.66 squared km

1.66 squared km * 3m = 0.004973617 cubic km

1.6 * 10^12 kg/cubic km * 0.004973617 cubic km = 7.96*10^9 kg or 7,960,000 metric tons

From 2018 to 2020 7,960,000 metric tons of sand were dumped into East Dhaka's wetlands. For just 2020 the amount is 7,960,000/2 = 3,980,000 metric tons.

DISCUSSION:

The sand mining activity in the country has clearly experienced massive growth. A single market in Dhaka in 2020 sees more than 4 times the entire country's consumption in 1990. While the Gobtali number is striking, the accuracy of the figure is incumbent on the reliability of the trader which cannot be verified. Furthermore, the value used for the weight capacity of the truck could have been under reported in an effort to circumvent weight load regulations.

Although the figure of 95% of imported concrete being of foreign origin, was for the year 1995, the import value was taken from 1997, because that was as far as OEC data records went. However, the GDP growth rate from 1995 to 1997 decreased from 5.1% to 4.5% indicating that it is unlikely that a large growth in the construction sector took place at this time [37]. It is likely that 1997 is an accurate reflection of 1995 gravel imports. The price per bag of concrete was a range form 1990-1995. These values were averaged with the import value and gave a result within the year of 1994, so 1994 was chosen as the year to choose the exchange rate. However, the exchange rate from 1990-1997 only changes by $0.06 of, not leaving a large room for fluctuation making the 1994 exchange rate an accurate choice [38]. These assumptions diminish the accuracy of the results, but for the reasons stated it is reasonable to assume that they provide a reasonably accurate estimate.

The gravel industry was mainly focused along the Sylhet border with India along the Shillong plateau (Figure 29). The ban on gravel mining has been harshly monitored and has halted Syhlet's production of gravel [39]. Bangladesh's gravel exports peaked at $8.52 million but slowly decreased to 36.6k by 2021. Now all crushed stones are imported abroad from countries such as the UAE and India [40]. Imported gravel represents 15,209,125.48 metric tons of the countries supply. Due to the closure of hard stone mines and quarries, it is unlikely that domestic production will make a significant contribution to this supply. At the height of their activity the Bangladesh Environmental Lawyers Association (BELA) claimed that the mining activity in this region accounted for only 7% of the countries gravel supply [41]. Of this import, 13,600,000 metric tons is used to produce concrete, representing nearly 90% of the usage.

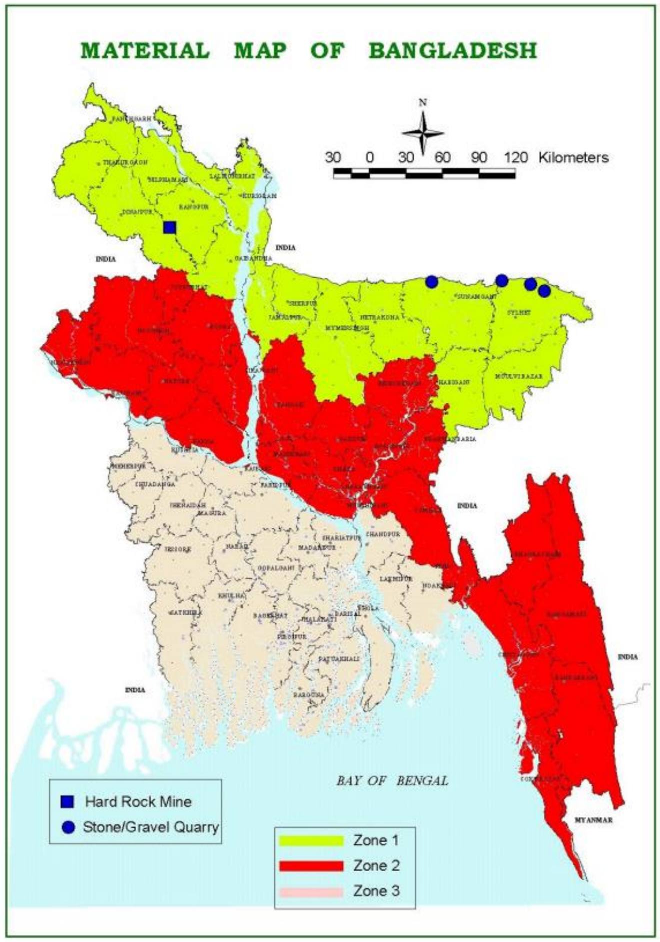


Figure 29: Map of Hard Rock and Stone/Gravel Quarries in Bangladesh [42].

There are differing reports on which countries source the most amount of silica sand to Bangladesh. IndexBox's reports that South Korea, Egypt, and China represent 75% of Bangladesh's silica sand imports while Volza reports that India, China, And Germany are responsible for the majority of imports [43, 44]. Each of these countries, especially India and Egypt regularly dominate Bangladesh's import figures, indicating that imports may be skewed towards silica sand as opposed to natural sand [45]. The average global cost of natural sand is about $1.40 per cft, while the average wholesale cost of natural sand in Bangladesh is $0.24 per cft [46]. The cheapness of domestic sand could skew imports to be focused on silica sand which is harder to obtain domestically. Therefore, the tonnage of imported sand is likely closer to 7,300.56 metric tons than 66,440.25 metric tons.

The amount of sand used for filling in east Dhaka, 3,980,000 metric tons, was 39.02% of the sand used to produce nearly all the concrete in the country (10,200,000 metric tons). The rate of increase from 2010 to 2020 has been very uniform so dividing by two to separate 2019 from 2020 dumping amounts should not skew the data too much. It is important to note however, that the height of 3 meters was a single anecdotal estimation from a worker in Purbachal and may not apply uniformly across East Dhaka. I time went on the western most Upazila, Rampura experienced nearly a complete halt in land filling by 2010. The furthest northern and southern upazilas, (Khilgaon and Sabujbagh + Demra + Jatrabari respectively) both stagnated at around

2.5 square km of land filling. Although Khilgaon's proximity to more productive areas such as Badda + Khilket allowed it to experience a faster rate of growth than the southern provinces they both stagnated at around 2.5 square km in 2018.

Badda + Khilket and Rupanganj + Kalinganj experienced by far the most land filling from 2001 - 2020 at 30.05 square km and 38.39 square km, respectively. Both areas were wetlands that required a large amount of filling to offset the lack of drainage in the area [47]. Badda + Khilket experienced a slower rate of progress that had much unplanned urban development present. Bushandara was the main large-scale project in this region with extensive forward planning. Rujpanganj + Kalinganj are host to exclusively large scale highly planned urban development neighborhoods such as Purbachal. As the land filling moved eastward, it hosted a larger area within a shorter time.

The growth in area of land filling East Dhaka tracks with the growth of sand and gravel consumption from 1990 – 2020. However, this can simply be attributed to the overall economic growth of the nation. However, the land filling weight indicates an impressive demand. The weight of sand used in landfilling is nearly 40% of the weight of sand used to satisfy the national concrete demand. Much of this concrete can also be expected to be used to develop the landfilled areas in East Dhaka to begin with.

CONCLUSION:

The threat of climate change and a rapidly growing economy induced a deluge of human capital into Dhaka. This induced a vast increase in demand for sand and gravel that has led to a high demand for housing. This spurred the rapid development of east Dhaka that started as unplanned urban sprawl and progressed into large scale planned developments as land filling ballooned eastward. This land filling alone equals 40% of the weight of sand used to satisfy the national concrete demand. This development has formed a large basis of the demand for sand and gravel within the nation for the past 20 years.

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